UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

SCANNER TECHNOLOGIES CORP.,

Plaintiff,

- against -

ICOS VISION SYSTEMS CORP., N.V.,

Defendant.

OPINION

00 Civ. 4992 (DC)

APPEARANCES: (See last page)

CHIN, D.J.

In this patent case, plaintiff Scanner Technologies Corp. ("Scanner") alleges that defendant ICOS Vision Systems Corp., N.V. ("ICOS") infringes the claims of two of Scanner's patents (the "Patents"): U.S. Patent No. 6,064,756 (the "'756 Patent") and U.S. Patent No. 6,064,757 (the "'757 Patent"). The parties waived their right to a jury and the case was tried to the Court. My findings of fact and conclusions of law follow.

FINDINGS OF FACT

A. The Parties

Scanner is a New Mexico corporation, with its principal office in Minneapolis, Minnesota. ICOS is a Belgian corporation with its principal office in Belgium. (Pl. PFF ¶¶ 1, 2).[1]

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[1] Citations to "Pl. PFF" and "Def. PFF" are to, respectively, Scanner's and ICOS's proposed findings of fact. I cite to a party's proposed finding of fact only where the other side did not contest the proposed finding. Where a proposed finding was contested, I cite only to the evidence. References to "Tr.," "PX," and "DX" are to, respectively, pages of the trial

B. Ball Grid Arrays

Ball grid arrays ("BGAs") and solder bumps on wafers and dies ("Bumps on Wafers") are electronic components that have small solder balls mounted on them in rows and columns that serve as electrical contact elements. (Tr. 31; PX 1 at col. 1; Def. PFF ¶ 1). BGAs are used in computer chips and can be found in devices such as personal computers, cellular telephones, electronic organizers, and compact disc players. Tens of billions of BGAs are produced every year. All the solder balls in each array must be positioned precisely at the same height, for a minute difference in height in any one ball in the array can render the BGA useless. Because the economics involved render repairs impractical, a defective BGA usually means the entire electronic device must be discarded. As a result, the industry has sought to develop an inspection machine to enable manufacturers of ball array devices to inspect BGAs and Bumps on Wafers in a fast and efficient manner. (Tr. 31-32).

The industry, including ICOS and Scanner, began searching for an apparatus and method for the three-dimensional inspection of ball array devices in the early 1990s. The Patents pertain to such an inspection device and method. (See PX 1; Tr. 33-36, 165, 450-51; Pl. PFF ¶ 20). The concept is to take two different views of the BGA and then to extrapolate three-

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transcript, Scanner's exhibits received at trial, and ICOS's exhibits received at trial.

dimensional information that will confirm the height of each ball. (Tr. 38).

Various kinds of inspection methodologies and types of inspection equipment have been available for some years for inspecting the solder balls on BGA devices. In particular, prior art to the Patents included laser range-finding technology, moiré interferometry, structured light pattern systems, and two-camera systems. (Def. PFF ¶ 2; PX 1 at col. 1).

C. The Patents

The '756 Patent is an apparatus patent entitled "Apparatus for Three Dimensional Inspection of Electronic Components." (PX 1). The '757 Patent is a method patent entitled "Process for Three Dimensional Inspection of Electronic Components." (PX 2). The Patents relate to the three-dimensional inspection of BGAs and Bumps on Wafers. (PX 1 at col. 1; Tr. 62).

Applications for the '756 and '757 Patents were filed on May 28, 1999, and the Patents were issued on May 16, 2000, to Elwin M. Beaty and David P. Mork -- the two inventors. (Pl. PFF. ¶ 6; PXs 1, 2; Tr. 61). Mork assigned his rights in the Patents to Beaty, the CEO and majority shareholder of Scanner. Beaty then granted Scanner an exclusive right to the Patents. (Pl. PFF ¶ 6; Tr. 61; PXs 145, 146).

D. The ICOS Projector System

ICOS has been working on the three-dimensional measurement of BGAs since 1993. (Tr. 569). As early as November

1993, ICOS recognized that a market was emerging for BGA technology. (Tr. 569; DX 31 at 016800). It recognized that three-dimensional inspection of BGAs was a major development, and that "stereovision" -- using two or more views of a camera -- looked "most promising" as a technology. (Tr. 571; DX 31 at 016805). It was obvious that the use of two or more cameras would require calibration of the cameras to obtain measurements. (Tr. 571-72). In addition, as early as November 1993, ICOS recognized that different triangulation techniques could be used to obtain three-dimensional information. (Tr. 573-74; DX 31 at 016802). The use of triangulation in two-camera vision systems has been well known since before 1997. (Def. PFF ¶ 3; Tr. 406, 757).

ICOS began developing a two-camera system for the inspection of BGAs, the "Projector" system, in 1993 or 1994 and began selling it in November 1996, with publicly available brochures. (Tr. 372, 586-88, 596; Def. PFF ¶¶ 9, 10, 11; DX 12). The Projector system used a first camera in a normal position and a second camera in a position angled from the normal, as well as structured light from a projector. (Def. PFF ¶ 4; Tr. 588). The Projector system was prior art to the Patents. (Def. PFF ¶ 5; PX 1 at col. 1).

The image taken by the first camera in the Projector system produced a donut-shaped image because of the use of a ring light. (Tr. 588; DX 12). The Projector system contained a processor coupled to receive data from the two cameras. (Tr.

589; DX 12). A calibration reticle then calibrated the two-dimensional camera. (Tr. 590; DX 12). A manual from October 1997 for the Projector system explained the use of a triangulation principle to perform three-dimensional measurements, including the use of Z calibration and bilinear interpolation. (Tr. 593-94; DX 33 at 013517, 013520).

E. The ICOS CyberSTEREO System

The Projector system had problems with speed and reliability because of its projector illumination source. In the summer of 1998 ICOS began to consider removing the projector from the Projector system and changing to something different. (Tr. 378-89, 408-09, 597-600). By the fall of 1998, ICOS's efforts to improve the three-dimensional measurement of BGAs were well under way. (DX 21; Tr. 380-81, 436, 451; see also Tr. 597-615; DXs 34-36, 38-43).

In the fall of 1998, ICOS began testing a prototype of a new BGA inspection system that would eventually become the CyberSTEREO. (Tr. 388-91, 451, 612-13; DXs 24, 25; see also Tr. 615-16; DX 44). The CyberSTEREO was announced on January 26, 1999, and ICOS described it as a system different from its Projector system. (Tr. 49; PXs 4, 101). ICOS started converting existing Projector systems to the new CyberSTEREO system by mid-February 1999. ICOS was shipping new CyberSTEREO modules by mid-1999. (Tr. 393-95; PX 4). Subsequent generations of the product were called CyberSTEREO II and 3D Stereo. (Pl. PFF ¶ 37).

The CyberSTEREO products are an outgrowth of the Projector system. (Tr. 374, 377). The Projector system was designed to measure the absolute value of the top of the balls of BGAs. (Tr. 376). When the projector was taken out of the Projector system for the CyberSTEREO, the computer code was changed so as to measure coplanarity -- whether the balls were lying in the same plane -- instead of measuring the absolute value of the top of the balls. (Tr. 377, 408-10, 450-52). In addition, the CyberSTEREO measures a point inside the ball rather than the top of the ball. (Tr. 581-82).[2] This measurement, which involves certain assumptions, is simpler and faster. (Tr. 582). The CyberSTEREO is also faster and more reliable than the Projector system. (Tr. 409-10, 596-97).

The CyberSTEREO uses two digital cameras: the first (the 2D camera) looks straight down at a glass surface and the second (the 3D camera) looks at the surface from an angle or side view. (Tr. 715-16; DX P at 2). The cameras observe fiducial marks (points of reference) on the surface and record their locations on the surface, in pixels, horizontally and vertically. For example, a mark at (50, 40) would be located at the 50th pixel on the X axis and the 40th pixel on the Y axis. (Tr. 715-17; DX P at 3). The two cameras, however, will "see" different

[2] The ICOS literature for the CyberSTEREO issued in February of 1999 inaccurately stated that the "ball top" was measured, for the measurement was actually of a virtual point inside the ball. (Tr. 574-76; DX 20 at 017491). This inaccuracy was carried over into other ICOS documents as well. (Tr. 585-86; DX 32). The inaccuracy continued in the documents through May 2002. (Tr. 631; PXs 11, 13).

locations in each camera's field of view because of the differing angles. Hence, four fiducial marks with locations of (30, 30), (70, 30), (30, 70), and (70, 70) as seen by the 2D camera would be seen, for example, as locations of (40, 40), (70, 30), (40, 80), and (70, 70) by the 3D camera. (Tr. 717-18; DX P at 4, 5). The shift is the result of the distortion caused by the differing perspective of the side camera. (Tr. 717).[3] The locations for both cameras are stored in computer memory and the CyberSTEREO computes the distances between the marks and some ratios of distances between the marks. This is the calibration process. (Tr. 717-18).[4]

The inspection process begins with the placing of a ball on the surface to be viewed by the cameras. The 2D camera sees the ball, for example, between two fiducial marks. The location as seen by the 2D camera is recorded, e.g., (40, 30). (Tr. 721; DX P at 6). The 3D camera sees the ball as being in a different location, e.g., (55, 35). (Tr. 721-22; DX P at 7).

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[3] The difference in location is the shift that occurs as a result of the differences in the angle. If one holds up a finger in front of one's right eye and focuses on a distant point, the finger will "shift" if the right eye and left eye are alternately opened and closed. If the finger is moved further away, the "shift" becomes noticeably less because the distance from the finger to the two eyes is greater and therefore the proportion of the shift is less. (Tr. 705-06).

[4] Calibration is the way of converting pixel values taken from the cameras and converting them into world values, i.e., inches or centimeters or microns. (Tr. 39). A "pixel" -- short for "pix [or picture] element" -- is "any of the small discrete elements that together constitute an image." Merriam-Webster's Collegiate Dictionary 885 (10th ed. 2000). A "micron" is a "micrometer," or the equivalent of one-millionth of a meter. Id. at 733-34.

The computer records this location as well and also computes the distances from the first fiducial mark to the center of the ball (D1) and from the center of the ball to the second fiducial mark (D2). (Tr. 722; DX P at 7). The ball is then "transferred" to the 2D camera, maintaining the distances D1 and D2 (respectively, from the first fiducial mark to the center of the ball and from the center of the ball to the second fiducial mark). "Transferred" means that the ball is placed in the approximate position where it should appear in the 2D camera, using the information obtained in the calibration process in a bilinear interpolation process. (Tr. 721-23).

The locations of the actual ball and the "transferred" ball in the 2D camera are compared as a ratio of distances, the distance between (1) the first fiducial mark and the center of the "transferred" ball and (2) the center of the "transferred" ball and the second fiducial mark. (Tr. 723-24). The comparison of the proportional distances is an approximation, not a trigonometric calculation. (Tr. 724). The distance between the centers of the two balls is the "shift," which is designated "dx" (DX P at 9), and ICOS assumes that the shift is proportional to the relative height of the ball. (Tr. 724-25). The higher the ball, the closer it is to the field of the view of the camera, in which case the "shift" appears bigger. (Tr. 725).[5] The dx is

[5] These examples involve the simpler situation of a ball lying on the line between two fiducial marks. The process is similar, but more complicated, if the ball is not on a line between two marks but in between. (See Tr. 725-27; DX P at 10, 11, 12, 13).

not measured at the top of the ball, but at the center of the ball, and even this is an approximation. (Tr. 733; DX P at 20).

All the calculations are done in pixel units. (Tr. 729). Because ICOS's customers prefer to deal in "real world coordinates" rather than "pixel coordinates," the pixel coordinates are converted to real world coordinates using "scale factors." (Tr. 730; DX P at 17, 18). Using the scale factors, the dx is converted from pixels to microns. (Tr. 731-33). The dx and scale factors are used to calculate -- or approximate -- the relative height, designated "dz." (Tr. 807; DX P at 18).[6] The dx and dz are relative or differential values, not referenced by any particular point. (Tr. 734). If the dz values for all the balls in a BGA are the same, then the balls are all the same height. (Id.). If the dz values are not the same, that would mean the balls in the BGA vary in height and there would be a lack of coplanarity. (Tr. 734-36; DX P at 21).

The formulas for the calculations and functions used in the CyberSTEREO calibration and inspection processes have been written into the computer source code. (Tr. 736-49; DX 49; PX 75A). Much of the computer code was drawn from the code used for the Projector system. (Tr. 738-39, 752-54; DX 72).

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[6] In the conversion process, a trigonometric function -- a tangent function -- is used, but this is not the use of a triangulation calculation to compute the unknown third side of a triangle. (Tr. 732, 773, 806-07; DX P at 18). Again, the ICOS calculation is an approximation.

F. The Scanner Device

Scanner invented an apparatus and method for the three-dimensional inspection of ball array devices in mid-1997, and filed a patent application on the apparatus and method in January 1998. (Pl. PFF ¶ 22; PXs 55, 176; Tr. 36-39). Scanner shipped its first embodiment of this invention, an inspection module called the Ultra Vim Plus ("UV+") in July 1998, to its distributor, Yamatake-Honeywell, which delivered the module to Syntax in Japan. (Pl. PFF ¶ 23; Tr. 41).

Also in July 1998, Scanner displayed a UV+ module at the Semicon West trade show in San Jose, California, and again in December 1998 at the Semicon Japan trade show. (Tr. 41, 93, 820).

G. ICOS's Inquiry About the UV+

Following the December 1998 Japan trade show, ICOS asked its various representatives to find out more about Scanner's UV+ system. (Tr. 399, 460-61; PXs 97, 159; Pl. PFF ¶ 29). In December 1998, DeProft suggested a meeting with Scanner's President, Beaty, to investigate a business relationship between the two companies. (Pl. PFF ¶ 33; Tr. 43-44, 436; DX 26). ICOS eventually sent Scanner a proposal to license the Scanner technology. (Tr. 48, 56, 384-85; PXs 3, 162; DX 23, 26). Scanner did not respond. (Tr. 218, 387).

Even as ICOS was approaching Scanner about a license, ICOS was continuing its efforts to modify its Projector system. (Tr. 385, 438-39). ICOS never, however, was given the

opportunity to examine Scanner's technology, and ICOS did not have detailed knowledge of the inner workings of the Scanner machine or its mathematics or calibration process. (Tr. 386-87, 398-99; see PX 97). ICOS never saw Scanner's source code and could not have known Scanner's mathematical calculations. (Tr. 219). In developing its CyberSTEREO, ICOS did not have in its possession any Scanner systems, notes, internal manuals, or pictures. (Tr. 618).

In February 1999, at the Anaheim trade show, DeProft and Verjans on behalf of ICOS met with Beaty and Mork on behalf of Scanner. The meeting lasted only a few minutes, and DeProft and Verjans told Beaty and Mork that ICOS was no longer interested in the proposal that it had sent Scanner earlier, as ICOS had introduced its own new system in the meantime. (Tr. 448-49). DeProft and Verjans did not ask Beaty and Mork whether Scanner had filed any patent applications. (Id.; see Tr. 215-16).

H. The Petition To Make Special

Shortly after it filed its patent application in May 1999, Scanner filed a "Petition To Make Special," alleging that ICOS was infringing on at least one of the claims in Scanner's then-pending patent application, and asking for "special handling" of the application because of ICOS's infringing conduct. (DX 3; Tr. 221).[7] In a supporting statement, Scanner's

[7] A petition to make special is, in essence, a request by an applicant for a patent to the Patent and Trademark Office to

attorney alleged that "I have made a rigid comparison of the . . . CyberSTEREO Ball Inspection System with the claims of the application, and . . . in my opinion, some of the claims are unquestionably infringed." (DX 5). In fact, the attorney had not seen the ICOS device at the time he made the statement. (Tr. 231, 543-44). Indeed, the attorney admitted at his deposition that he had not seen any ICOS products, not even on videotape. (Leone Dep. 20-21). It appears that he was relying on information given him by Beaty. (Tr. 546).[8]

Beaty signed a statement, under penalty of perjury, in support of the Petition. (DX 4). The statement alleged that: the UV+ was on "open display" at the December 1998 trade show; DeProft approached Beaty for a two-hour private meeting; DeProft had previously inspected the UV+ at the July 1998 trade show in California; DeProft "took copious notes, diagrams, and drawings" of the UV+ at the Japan trade show; other ICOS personnel "also rigorously studied the [Scanner] display" at the Japan trade show; according to a former ICOS employee,[9] after the July 1998

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expedite the application and take it out of order. One basis for doing so is that "unquestionably" there is actual infringement with respect to at least some of the claims of the patent. The applicant must make such a representation, and the applicant has a duty of candor to be as forthright and truthful as possible. (Tr. 533-37).

[8] Scanner's counsel did not permit the attorney to answer, at his deposition, how he performed the "rigid comparison" referred to in his declaration to the PTO. (Leone Dep. 20).

[9] This former ICOS employee, James McLaughlin, had joined Scanner. (DX 4 ¶ 27). As McLaughlin acknowledged at his deposition, although he represented when he applied for

trade show it was suggested at an ICOS meeting that a third party buy the UV+ so that ICOS could see how it worked; ICOS contacted Scanner in December 1998 about obtaining rights to the UV+; and on January 26, 1999, ICOS announced the introduction of its CyberSTEREO system, which Beaty described as being "substantially identical" to the UV+. (DX 4 at 2-3).

Several of Beaty statements in his submission were false or misleading. The UV+ was not on "open display" at the December 1998 trade show, at least not in the sense that Beaty tried to convey, for visitors to the booth could not see inside the device to any meaningful degree. Rather, the system was in a black sealed box, and an inspection of the module would not reveal how the calculations were performed. DeProft did not visit the Scanner booth at the July 1998 trade show. DeProft did not take "copious notes" or make any diagrams or drawings of the UV+ at the Japan trade show. (Tr. 435-41, 453-57, 505-07; see Tr. 185, 211, 224; DXs J, K, L).[10]

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employment with ICOS that he had received a bachelor of science degree from the University of Maine, this was false as he never graduated from the University of Maine and never received a degree from that institution. (McLaughlin Dep. 162-70).

[10] At trial, Beaty testified that he did not recall "having much of an interaction" with DeProft at the July 1998 trade show (Tr. 91), and that he could not recall "anything specific" with respect to DeProft at that show. (Tr. 205). He also testified that at the December 1998 trade show he met with DeProft for "one or two hours." (Tr. 206). He testified that he then permitted DeProft to spend half an hour with the module, taking notes and drawing pictures and diagrams, and that DeProft asked him whether he had filed a patent application. (Tr. 210, 213, 215). He testified that he had no knowledge that ICOS ever actually had a third party purchase the UV+ to study. (Tr. 228-29).

At the time Scanner's attorney was preparing the Petition To Make Special, he re-wrote the claims of the Patents to track ICOS's literature as closely as possible. (Tr. 235; see Leone Dep. 14). The Petition was granted, the application process was accelerated, and the Patents were issued in May 2000. (Tr. 235).

I. ICOS's Patents

After the Scanner patents were filed on May 28, 1999, and before they issued on May 16, 2000, ICOS filed an international patent application on March 1, 2000, under the Patent Cooperation Treaty, entitled "Measuring Positions of

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In contrast, DeProft testified that, although he was at the July 1998 trade show, he did not visit with Scanner or see or learn anything about Scanner or inspect any Scanner device there. (Tr. 435-36). He testified that at the December 1998 show he did visit the Scanner booth and speak to and meet with Beaty. He testified that he did not, however, inspect Scanner's module or make any drawings, diagrams, or notes regarding the module, although on cross he acknowledged that he might have made a few notes regarding some numbers. (Tr. 436-41, 505-07; see also Tr. 453-57; DX 29). DeProft also testified that although he is an engineer by education, he had not been a practicing engineer for some twenty years and did not have the ability to understand the technology or mathematics merely by looking at what was on display; his interest was in finding out whether there was "an opening to start more business discussions." (Tr. 441-42).

As for these conflicts in the testimony, I accept DeProft's testimony and reject Beaty's. Beaty knew that DeProft was a competitor and it does not make sense that he would have permitted DeProft to poke around and take copious notes for half an hour. (See Tr. 210, 215). To the extent Mork testified that he gave DeProft a computer demonstration at the Japan 1998 show (Tr. 820-23), the testimony is also rejected. Mork did not so testify until Scanner's rebuttal case; he did not testify that he gave such a demonstration to DeProft either during his testimony on Scanner's direct case or during his deposition in discovery. (Tr. 833-34).

Coplanarity of Cont[]act Elements of an Electronic Component with a Flat Illumination and Two Cameras." (DX 13). ICOS's patent application disclosed a "method for measuring respective positions of a set of N contact elements of an electronic component." (DX 13 at 1).

ICOS was issued a U.S. patent, Patent No. 6,778,282, for its CyberSTEREO invention on August 17, 2004. (PX 61; Tr. 513).

J. The Claims

Scanner alleges that the ICOS CyberSTEREO products infringe claims of the '756 and '757 Patents. (Pl. PFF ¶ 9; Def. PFF ¶ 7). As the parties agree, construction of the disputed terms in Claim 1 of the '756 Patent is controlling with regard to the language in the remaining claims. Scanner Techs. Corp. v. ICOS Vision Sys. Corp., No. 00 Civ. 4992 (DC), 2002 WL 44135, at *1 n.1 (S.D.N.Y. Jan. 11, 2002). (See also Pl. PFF. ¶ 9; Def. PFF ¶ 37).

Claim 1 of the '756 Patent is used as a representative claim. Additionally, as the language in the Scanner patents is nearly identical, references are to the '756 Patent, unless otherwise specified.

Claim 1 of the '756 Patent reads as follows:

> 1. A three dimensional inspection apparatus for ball array devices having a plurality of balls, wherein the ball array device is positioned in a fixed optical system, the apparatus comprising:

> a) an illumination apparatus positioned for illuminating the ball array device;[11]
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> b) a first camera disposed in a fixed focus position relative to the ball array device for taking a first image of the ball array device to obtain a characteristic circular doughnut shape image from at least one ball;
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> c) a second camera disposed in a fixed focus position relative to the ball array device for taking a second image of the ball array device to obtain a side view image of the at least one ball; and
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> d) a processor, coupled to receive the first image and the second image, that applies triangulation calculations on related measurements of the first image and the second image to calculate a three dimensional position of the at least one ball with reference to a pre-calculated calibration plane.

(PX 1 col. 18:34-53).

As construed by this Court and the Federal Circuit, the claim terms of the Patents mean as follows:

> A. "an illumination apparatus" and "illuminating" encompass one or more illumination sources;
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> B. "side view" is not limited to a view that produces a crescent shape; the viewing angle is not a 90 degree angle, a top angle, or an angle identical to the one created by the first camera; and the viewing angle is not limited to a "low angle";

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[11] Claim 1(a) of the '757 Patent reads instead: "the process comprising the steps of: a) illuminating the ball array device."

> C. "triangulation" is, as defined in The Photonics Dictionary, "[a] method of measuring distance by recording a single scene from two different points of perspective," and a "triangulation calculation" involves the use of trigonometric principles;
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> D. "three dimensional position" means the X, Y, and Z values for the top half of at least one ball of a BGA; and
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> E. "pre-calculated calibration plane" means the X and Y coordinates and the Z=0 world plane.

(Pl. PFF ¶ 12). See Scanner Techs. Corp. v. ICOS Vision Sys. Corp., N.V., 365 F.3d 1299, 1304 (Fed. Cir. 2004); Scanner Techs. Corp. v. ICOS Vision Sys. Corp., N.V., No. 00 Civ. 4992 (DC), 2002 WL 44135, at *8 (S.D.N.Y. Jan. 11, 2002).

DISCUSSION

Scanner claims that the ICOS products infringe on the Patents. ICOS denies infringement and further argues that the Patents are invalid because (1) Scanner engaged in inequitable conduct, (2) Scanner failed to disclose the best mode contemplated by the inventor for carrying out the invention, and (3) the differences between the Scanner invention and prior art would have been obvious to a person of ordinary skill in the art.

A. Scanner's Claims of Infringement

1. Applicable Law

A two-step analysis is required in considering patent infringement claims. Cybor Corp. v. FAS Techs., Inc., 138 F.3d 1448, 1454 (Fed. Cir. 1998). First, the court construes the

patent by determining the scope and meaning of the patent claims asserted. Id. (citing Markman v. Westview Instruments, Inc., 517 U.S. 370, 371-73 (1996)). Second, the claims, as construed, are compared with the accused device to determine if an infringement occurred. Id.; see also Amgen Inc. v. Hoechst Marion Roussel, Inc., 314 F.3d 1313, 1324 (Fed. Cir. 2003).

a. Construction

The construction of a patent is a question of law for the court. Markman, 517 U.S. at 372. Patent construction lies within the province of the court because the judge, based on his or her training and discipline, is generally more qualified than a jury to interpret patent terms. Id. at 388-89.

A patent consists of a written description called the specification, which is usually accompanied by drawings, and the claims. The claims are at the end of the patent and define the invention. 35 U.S.C. § 112; Markman, 517 U.S. at 373. A claim may be independent or dependent. 35 U.S.C. § 112. A dependent claim refers to a claim previously set forth and specifies an additional limitation of the invention. Id.

In determining claim construction, the court first considers intrinsic evidence. Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582 (Fed. Cir. 1996). The court can rely on extrinsic evidence only in the event that intrinsic evidence alone does not resolve the ambiguities. Id. at 1583.

Intrinsic evidence includes the language of the patent -- including the claims and specifications -- and the prosecution

history. Id. at 1582; Hsin Ten Enter. USA, Inc. v. Clark Enters., 149 F. Supp. 2d 60, 63 (S.D.N.Y. 2001). "A technical term used in a patent document is interpreted as having the meaning that it would be given by persons experienced in the field of the invention, unless it is apparent from the patent and the prosecution history that the inventor used the term with a different meaning." Hoescht Celanese Corp. v. BP Chems. Ltd., 78 F.3d 1575, 1578 (Fed Cir. 1996) (citations omitted). "There is a heavy presumption in favor of the ordinary meaning of claim language." Kraft Foods, Inc. v. Int'l Trading Co., 203 F.3d 1362, 1366 (Fed. Cir. 2000) (internal quotation omitted).

In construing a claim, the court may not import an additional limitation into the claim. It is an entirely appropriate practice, however, for the court to look to the specification to aid its interpretation. Ethicon Endo-Surgery, Inc. v. United States Surgical Corp., 93 F.3d 1572, 1578 (Fed. Cir. 1996) (citation omitted). "Although the written description may aid in the proper construction of a claim term, limitations, examples, or embodiments appearing only there may not be read into the claim." Kraft Foods, 203 F.3d at 1366.

The court may also consider the patent's prosecution history -- that is, the record of proceedings before the Patent and Trademark Office. Vitronics, 90 F.3d at 1582. Although the prosecution history may be used to assist in construing the claims, it may not "'enlarge, diminish, or vary' the [claim] limitations." Hsin Ten, 149 F. Supp. 2d at 63 (quoting Markman

v. Westview Instruments, Inc., 52 F.3d 967, 980 (Fed. Cir. 1995), aff'd, 517 U.S. 370 (1996)).

If intrinsic evidence, alone, is not sufficient to resolve all claim disputes, the court looks to extrinsic evidence. Vitronics, 90 F.3d at 1583; Hsin Ten, 149 F. Supp. 2d at 64. Extrinsic evidence is evidence outside the patent language and file, including expert and inventor testimony, dictionaries, and treatises. Key Pharms. v. Hercon Labs. Corp., 161 F.3d 709, 716 (Fed Cir. 1998) (citing Markman, 52 F.3d at 980). The court, in its own discretion, may consider extrinsic evidence for background and education, but it may not use such evidence to contradict the terms in the claims. Key Pharms., 161 F.3d at 716 (citing Markman, 52 F.3d at 980-81).

b. Infringement

Once a claim has been construed, the second step of the analysis is to determine whether the accused device infringes the claim, either literally or under the doctrine of equivalents. The question of infringement is a question of fact, both for literal infringement and infringement under the doctrine of equivalents. Bai v. L&L Wings, Inc., 160 F.3d 1350, 1353 (Fed. Cir. 1998); In re Omeprazole, 222 F. Supp. 2d 423, 503 (S.D.N.Y. 2002), aff'd, 84 Fed. Appx. 76, 2003 WL 22928641 (Fed. Cir. Dec 11, 2003).

To prove literal infringement, the patentee must demonstrate that the accused product or method includes each and every element or limitation of the claims in question. See

Transmatic, Inc. v. Gulton Indus., Inc., 53 F.3d 1270, 1277 (Fed. Cir. 1995); Baxter Healthcare Corp. v. Spectramed, Inc., 49 F.3d 1575, 1582 (Fed. Cir. 1995). It is the patentee's burden to show literal infringement by a preponderance of the evidence. Braun Inc. v. Dynamics Corp., 975 F.2d 815, 819 (Fed. Cir. 1992).

A device that does not literally infringe a claim may nonetheless infringe under the doctrine of equivalents if every element of the claimed invention, or its "equivalent," is found in the accused product or method. Eagle Comtronics, Inc. v. Arrow Commc'n Labs., 305 F.3d 1303, 1315 (Fed. Cir. 2002); see Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17, 21 (1997). "The scope of a patent is not limited to its literal terms but instead embraces all equivalents to the claims described." Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd., 535 U.S. 722, 732 (2002). Claimed limitations are considered "equivalent" if there is only an "insubstantial difference" between the claimed element and the corresponding element in the accused device. Sage Prods., Inc. v. Devon Indus., Inc., 126 F.3d 1420, 1423 (Fed. Cir. 1997). To infringe under the doctrine of equivalents, the accused product or method must perform substantially the same function, in substantially the same way, to achieve substantially the same result as the patented product or method. Eagle Comtronics, 305 F.3d at 1315 (quoting Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 608 (1950)); Dolly, Inc. v. Spalding & Evenflo Cos., 16 F.3d 394, 397 (Fed. Cir. 1994).

2. Application

The claim terms have already been construed by this Court and the Federal Circuit. The Patents teach a three-dimensional inspection apparatus for BGAs, where a BGA is positioned in a fixed optical system, using (a) one or more illumination devices positioned to illuminate the BGA, (b) a first camera in a fixed focus position relative to the BGA for taking a first image to obtain a characteristic circular doughnut shape image from at least one ball, (c) a second camera in a fixed focus position relative to the BGA taking a second image to obtain a side view (not a 90-degree angle, nor a top view angle, nor an angle identical to the one created by the first camera, and not limited to a low angle) of the ball, (d) a processor that receives both images and applies triangulation calculations (a method of measuring distance by recording a single scene from two different points of perspective, using trigonometric principles) on related measurements of the first and second images to calculate a three-dimensional position of at least one ball (the X, Y, and Z values for the top of at least one ball in the BGA) with reference to a pre-calculated calibration plane (the X and Y world coordinates and the Z=0 world plane). (PX 1 col. 18:34-53; Pl. PFF ¶¶ 12). See Scanner, 365 F.3d at 1304; Scanner, 2002 WL 44135, at *8.

As for infringement, the parties agree that the ICOS products comprise the preamble and elements a, b, and c of Claim

1, but disagree as to element d. I agree with ICOS, and I conclude that the ICOS products do not include element d.

Element d teaches the use of triangulation calculations while the ICOS products rely on bilinear interpolation. Triangulation calculations are used to find the third side of a triangle using a known angle, a right angle, and a known distance. (See Tr. 154, 704; PX 1 at fig. 6B). In a triangulation calculation, an unknown measurement -- for example, the height of a building -- can be determined by measuring off a distance from the base of the building and then measuring the angle with a sextant from that spot to the roof of the building. With these and a third known property -- the right angle formed where the ground meets the building -- the height can be calculated using basic trigonometry. (Tr. 713-14; see DX P at 1). As Beaty testified:

> Q. . . . What you're using is you're using the right angle, the angle theta which is 262 [in figure 6B], and the distance L1, these three properties in order to solve the triangle, is that right?
>
> A. Yes, that's correct.
>
> Q. And that's the triangulation calculation that's referred to in claim 1[d], correct, sir?
>
> A. That's correct.

(Tr. 154; PX 1 at col. 18).

ICOS uses bilinear interpolation -- the process of transferring the location of a ball from the 3D camera into the 2D camera and then computing a translation offset. (Tr. 704).

First, a position of the ball in the 3D camera is measured. Second, using a camera-to-camera transfer process, that position is relocated in the 2D or top camera. Third, that position is compared to the location of the ball as observed directly in the 2D camera. The difference in these two locations is proportional to the height of the ball. Bilinear interpolation is different from triangulation, as it is an algebraic operation rather than a trigonometric one, and it does not involve solving for unknown properties of a triangle. (Tr. 594, 869-70). The ICOS source code does not use triangulation calculations to measure the height of balls. (Tr. 732-33).

While it is true that ICOS uses a trigonometric function in the calibration process, it is not making or using triangulation calculations. (Tr. 732-33; see also 321-22).[12] Significantly, ICOS is not measuring the top of a ball or even a virtual point at the top of the ball, but instead it is making an approximation only, relying on the location of a virtual point approximately at the center of the ball. It calculates the theoretical "shift" in the ball location from the 3D camera to the 2D camera. Although this method is not as accurate a measurement as triangulation, ICOS has made the judgment that it is worth giving up a little bit of accuracy in return for speed. (Tr. 149, 594, 707). ICOS has determined that the use of

[12] Likewise, the references in the ICOS literature to "triangulation" were more generic in nature and were not meant to convey the use of precise measurements using trigonometric principles. (Tr. 573-74, 577).

relative measurements and approximations, even though not precisely accurate, was acceptable to the marketplace. (Tr. 706-08, 807-08). The difference between approximations made through bilinear interpolation and precise measurements through triangulation is significant.

In addition, the ICOS products do not use a precalculated calibration plane. (Tr. 703-04). They do not locate X, Y, and Z values for the top (or virtual top) of a ball. (Tr. 373, 452). Instead, they locate a reference point inside the ball. (Tr. 582; DX 20 at 3). This was a change from the Projector system to improve speed and reliability. (Tr. 581-82). The ICOS products do not need to measure the height of the ball because they rely on coplanarity -- the relative variations of each ball from a plane. (Tr. 450-52, 581). The ICOS products do not make calculations with reference to a pre-calculated calibration plane. (Tr. 718). Instead, they use a camera-to-camera calibration that does not involve the calculation of a calibration plane. (Tr. 595).

In short, Scanner has not proven that each and every element of its claims -- or their equivalent -- is found in the ICOS devices. Accordingly, Scanner's claims of infringement fail. Moreover, alternatively, Scanner's infringement claims must also be dismissed because, as I conclude below, the Patents are unenforceable.

B. ICOS's Claims of Invalidity

1. Applicable Law: Patent Invalidity

Patents issued by the Patent Office are presumed valid. 35 U.S.C. § 282. To overcome this presumption of validity, the party challenging the patent bears the burden of proving invalidity by clear and convincing evidence. Oakley, Inc. v. Sunglass Hut Int'l, 316 F.3d 1331, 1339 (Fed. Cir. 2003); Apotex USA, Inc. v. Merck & Co., 254 F.3d 1031, 1036 (Fed. Cir. 2001); Johns Hopkins Univ. v. CellPro, Inc., 152 F.3d 1342, 1359 (Fed. Cir. 1998). ICOS contends that the Patents are invalid for inequitable conduct, failure to use best mode, and obviousness.

a. Inequitable Conduct

A party alleging that a patent is invalid for inequitable conduct must prove, by clear and convincing evidence, that the patentee or its agents submitted false or misleading material information or failed to disclose material information with an intent to deceive the Patent and Trademark Office (the "PTO"). Bristol-Myers Squibb Co. v. Rhone-Poulenc Rorer, Inc., 326 F.3d 1226, 1233 (Fed. Cir. 2003); Kingsdown Med. Consultants, Ltd. v. Hollister Inc., 863 F.2d 867, 872 (Fed. Cir. 1988). Patent applicants have a duty of candor and good faith in all dealings with the PTO and a breach of this duty may give rise to finding of inequitable conduct. Bristol-Myers, 326 F.3d at 1233; Molins PLC v. Textron, Inc., 48 F.3d 1172, 1178 (Fed. Cir. 1995). A party that obtains a patent by misleading the PTO is precluded,

by the doctrine of unclean hands, from enforcing the patent. General Electro Music Corp. v. Samick Music Corp., 19 F.3d 1405, 1408 (Fed. Cir. 1994).

Inequitable conduct includes the submission to the PTO of information that is materially false, whether by affirmative misrepresentations or the omission of material information, coupled with an intent to deceive. PerSeptive Biosystems Inc. v. Pharmacia Biotech, Inc., 225 F.3d 1315, 1318 (Fed. Cir. 2000); Molins, 48 F.3d at 1178. Both materiality and an intent to mislead must be established. Id. at 1318-19; Molins, 48 F.3d at 1178. But once threshold levels of both have been established, the two are weighed; the more material the misrepresentation, the less evidence of intent is required for a finding of inequitable conduct. PerSeptive Biosystems, 225 F.3d at 1319.

The Federal Circuit has concluded "as a matter of law that a false statement in a Petition to Make Special is material if . . . it succeeds in prompting expedited consideration of the application." General Electro, 19 F.3d at 1411. Intentionally making a false or misleading statement in a Petition to Make Special is inequitable conduct and renders a resulting patent unenforceable. Id.

b. Best Mode

A patent specification "shall set forth the best mode contemplated by the inventor of carrying out his invention." 35 U.S.C. § 112 ¶ 1. If the applicant develops specific instrumentalities or techniques that are recognized at the time

of filing as the best way to carry out the invention, the best mode obligation requires the inventor to disclose that information as well. Spectra-Physics, Inc. v. Coherent, Inc., 827 F.2d 1524, 1532 (Fed. Cir. 1987). Inventors are not permitted to apply for patents while concealing from the public preferred embodiments of their inventions that they have actually conceived. Id.

A party seeking to invalidate a patent for failure to disclose best mode must prove, by clear and convincing evidence, that at the time of the application the inventor: (1) subjectively possessed a best mode for practicing the invention, and (2) objectively failed to adequately disclose the mode he considered to be superior. Teleflex, Inc. v. Ficosa North America Corp., 299 F.3d 1313, 1330 (fed. Cir. 2002); Chemcast Corp. v. Arco Indus. Corp., 913 F.2d 923, 926 (Fed. Cir. 1990).

c. Obviousness

A patent may be invalid if there are prior art references that motivate a person of ordinary skill in the art to make the claimed invention:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

35 U.S.C. § 103(a). An obviousness inquiry involves examining the combination of elements in multiple prior art references.

Obviousness is ultimately a question of law that is based on underlying facts. Sandt Tech., Ltd. v. Resco Metal & Plastics Corp., 264 F.3d 1344, 1354 (Fed. Cir. 2001); ATD Corp. v. Lydall, Inc., 159 F.3d 534, 546 (Fed. Cir. 1998). The fact finder must consider: "1) the scope and content of the prior art; 2) the differences between the prior art devices and the claimed invention; 3) the level of ordinary skill in the art; and 4) objective considerations, such as commercial success, long felt need, failure of others, and copying." Sandt, 264 F.3d at 1354 (citing Graham v. John Deere Co., 383 U.S. 1, 17-18 (1966)); see also ATD, 159 F.3d at 546. These factual inquiries must be considered from the perspective of a person with ordinary skill in the relevant art. Ecolochem, Inc. v. S. Cal. Edison Co., 227 F.3d 1361, 1371 (Fed. Cir. 2000); Al-Site Corp. v. VSI Int'l, Inc., 174 F.3d 1308, 1323 (Fed. Cir. 1999); In re Rouffet, 149 F.3d 1350, 1357 (Fed. Cir. 1998).

Additionally, for a patent to be obvious in light of the prior art teachings, the party challenging patent validity must show some motivation or suggestion to combine the various references. Al-Site, 174 F.3d at 1323-24. The motivation to combine prior art references need not be explicit but may be inferred from three possible sources: "the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art." In re Rouffet, 149

F.3d at 1357. In some situations, where the prior art and the invention at issue are relatively straightforward, the motivation to combine may be "apparent without more." Display Techs., Inc. v. Paul Flum Ideas, Inc., 60 Fed. Appx. 787, 794, 2002 WL 32066815, at *6 (Fed. Cir. March 4, 2002).

2. Application

a. Inequitable Conduct

Beaty and Mork, through their patent counsel, filed a Petition To Make Special with supporting declarations alleging that the ICOS devices "unquestionably" infringed on the claims in their application. The PTO granted the Petition and expedited the application, and the Patents were issued. The PTO relied on statements contained in the supporting declarations.

Scanner's counsel had not actually seen the ICOS device, as he suggested. ICOS had not copied the Scanner device, as Beaty suggested in his declaration. The UV+ was not on "open display" at the December 1998 trade show, at least not in the sense that Beaty tried to convey, for the system was in a black sealed box and an inspection of the module would not have revealed how the calculations were performed. DeProft did not visit the Scanner booth at the July 1998 trade show, as Beaty stated. Contradicting what he wrote in his declaration, Beaty acknowledged at trial that he could not recall "anything specific" with respect to DeProft at that show. (Tr. 205). DeProft did not take "copious notes" or make any diagrams or drawings of the UV+ at the Japan trade show, as Beaty alleged as

well. Beaty's statements were intended to mislead the PTO into believing that ICOS had copied the Scanner invention based on what it saw at the trade shows. In fact, ICOS's internal documents show that ICOS developed the CyberSTEREO from the Projector system, on its own, over a period of time prior to Scanner's application for the Patents.

I find by clear and convincing evidence that Scanner's conduct was inequitable; the misrepresentations were material, and Scanner intended to mislead the PTO. The PTO indeed was "prompted" into giving Scanner expedited treatment. Hence, the Patents are unenforceable for inequitable conduct.

b. Best Mode

I am not persuaded, by clear and convincing evidence, that Beaty and Mork failed to disclose to the PTO, at the time they applied for a patent, a best mode for carrying out the invention of which they were aware. I am not persuaded that Beaty possessed a preferred "best mode" of illumination for practicing the invention.

This defense is rejected.

c. Obviousness

I hold, as a matter of law, that the Patents are also unenforceable for obviousness.

All camera-based systems require some form of lighting to illuminate the object and acquire the image. (Tr. 144). Illumination was known in the prior art. (Tr. 144-45). Two-camera systems, with one camera disposed at an angle to a normal

camera, were known in the prior art. (Tr. 145). The Projector system used two cameras, an illumination system that generated a top view and a side view, and computed three-dimensional measurements. (Tr. 755). The use of triangulation calculations to make measurements was also well-known. (Tr. 755-56). Triangulation calculations utilized with a two-camera system were known in the prior art. (Tr. 146-47). The concept of using stereo vision was known as well. (Tr. 756). The idea of calibrating cameras was not new or novel as of 1997 or 1998. (Tr. 757).

The ICOS Projector system renders the claims of the Patents obvious. Every element of the Scanner claims is present or suggested in the Projector system. The Projector system contained a first and second camera, an illumination apparatus, and a processor coupled to the cameras to receive first and second images to find the three-dimensional position of at least one ball. One skilled in the art would have found it obvious at the time of the Scanner invention to employ the elements of the claims in the Patents to alter the Projector system. One skilled in the art would have found it obvious to remove the structured light source and employ triangulation calculations to locate the three-dimensional position of balls.

Accordingly, I hold that the Patents are also void for obviousness.

CONCLUSION

Judgment will be entered against Scanner and in favor of ICOS, to the extent set forth above, with costs. ICOS shall submit a proposed judgment on notice within five business days hereof. Counsel for the parties shall appear for a conference on May 30, 2007 at 9:30 a.m. in Courtroom 11A of the United States Courthouse at 500 Pearl Street to discuss the related cases and motions pending therein.

SO ORDERED.

Dated: New York, New York
May 22, 2007

DENNY CHIN
United States District Judge

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[13] After the case was tried, Roberts Abokhair & Mardula, LLC, was replaced by Vytas M. Rimas, Esq.

[14] After the case was tried, Brown Rudnick Freed & Gesmer, P.C., was replaced by R. Kunstadt, P.C.